

XII. *On the supposed abnormal habits of certain species of Eurytomides, a group of the Hymenopterous family Chalcididae.* By J. O. WESTWOOD, M.A., F.L.S., &c.

[Read May 3rd, 1882.]

PLATES XIII. and XIV.

IN the memoir on the insects infesting the seeds of *Ficus Sycomorus* and *Carica*, recently published (Trans. Ent. Soc. Lond., 1882, pp. 47—60), I have suggested that notwithstanding the phytophagous character of the two remarkable insects, *Sycophaga crassipes* and *Blastophaga Psenes*, they were more nearly related to the entomophagous *Chalcididae* than to any other family of Hymenoptera. The question of the possibility of so close a relationship between animals differing so widely as to possess phytophagous and sarcophagous habits is one of great physiological interest, and appears to be affirmed not only by the case of the *Cynipidae* alluded to in my memoir, as well as by that of *Bombus* and *Psithyrus*, but also by the various instances of phytophagism stated to have been observed in certain species of the *Eurytomides*, whilst others in the latter group have certainly been ascertained to be entomophagous in their habits. It is true that the phytophagism of *Eurytoma hordei* and its immediate allies has been questioned and again reaffirmed, so that a very careful examination of the statements made on either side is required, and I now beg leave to lay the result of my examination of the chief authorities upon this curious question before the members of the Entomological Society without prejudging their verdict, which may, however, I think, now be given.

The late Mr. F. Walker published a Monograph of the British *Eurytomides* in the first volume of the 'Entomological Magazine' (October, 1832). In this memoir four genera are described—1, *Isosoma*, Walk., with twenty-three species; 2, *Systole*, Walk., one species; 3, *Eurytoma*, Illiger, eleven species; and *Decatoma*, Spinola, ten species. Almost all the species are described as having

been taken amongst grass beneath trees, the only novel remark on the economy of the species being that Mr. Davies had obtained an individual of the genus *Decatoma* from an oak-gall. In the second volume of the same magazine Mr. Walker adds descriptions of one additional species of *Isosoma*, one of *Systole*, five of *Eurytoma* (one of which, *E. salicis*, was reared by M. F. de Laporte from galls on willows near Paris), and two of *Decatoma*. And in the fourth volume of the same work three additional species of *Isosoma*, one *Eurytoma*, and three of *Decatoma* were described by Mr. Walker, with no account of the economy of any of the species.

C. G. Nees ab Esenbeck, in the second volume of his 'Hymenopterorum Ichneumonibus affinium Monographiæ,' 1834, has described eight species of *Eurytoma*, with the general observation:—"Habitat in Carduis, Artemisiis aliisque herbis et fruticibus, ubi gallas fungosas ictu suo gignere dicuntur hujus generis species. Adnot. Latreillum et Dalmanum secutus *Eurytomæ* genus inter Pteromalinos posui, quibus re vera habitu notisque ex antennis alisque haustis proxime conjunctum videtur; sed vitæ ratio Cyniphum potius est, quibus Eucharide genere medio conciliatur, neque errabit, qui, utriusque ordinis, Cyniphum et Pteromalinorum inquam, novo certiorique caractere invento, Eurytomas Cyniphibus restituet" (*op. cit.*, pp. 38 & 39).

The following are the species of which the economy is recorded by this author:—

Eurytoma plumata, Illiger (*serratulæ*, Fab.; ♀, *compressa*, Fab.; *adonidum*, Rossi). "Habitat in galla lignea polythalama, rotundata, utrinque attenuata, caulis *Serratulæ arvensis* galliæ (Fabricius, auctoritate Musei Bosciani"* (p. 40).

E. Abrotani, Illig., Panz. (*P. appendigaster*, Swederus; ♀, *aterrimus*, Schrank; *P. nigritus*, Swederus). "In Galla caulis cujusdam tuberosa, plantæ ab hieme destructæ ideoque incertæ, Parietariæ forte, copiam feminarum invenit Schrankius. In Carduis prope Sickershausen Julio, Augusto et Septembri mensibus, ipse legi; marem feminae copula junctum die 21 Aug. a. 1821; in variis

* According to Bonché, *Naturg. d. Ins. i.*, p. 166, n. 58, the larva is "elongato-cylindrica, subtiliter undulata, incisuris profundis segmentis dorsalibus gibbosis, capite subgloboso. Long. lin. 1. Habitat in larvis *Microgasteris liparidis*, Bonché, et in iisdem metamorphosin subit."

plantis prope Norimbergam, Panzer; prope Viennam inventa est; etiam in Gallia et Suecia" (p. 41). And in the Addenda, p. 415, it is further stated:—"Habitat in Gallis Cyniphis Potentillæ mihi, Februario mense anni 1834, in horto botanico Vratislaviensi lectis. Exclusis primum inde a die 26 Martii Cyniphibus plurimis utriusque sexus, mox etiam *Eurytomæ* multæ prodire."

E. verticillata, Illig., Fabr. (*abrotani*, Fonscol.) "Cepi mares et feminas promiscue, in variis floribus vere et æstate prope Sickershausen. Feminam, in galla parva globosa sanguinea Folii Rosæ insidentem, misit cl. Gravenhorst, hoc situ a sese prope Brunsvicum captam" (p. 41).

E. ænea, Esenb. (*Decatoma metallica*, Spinola. "Unam hujus speciei feminam cepi, Aphidibus, jam mortuis, Aphidio vario imprægnatis, terebra immissa ova impo-nentem, die 11 Junii a. 1813, in Rosa horti mei prope Sickershausen. Marem non vidi" (p. 42).

E. signata, Esenb. "Plura hujus speciei exempla utriusque ea variationis, prodire diebus 12 et 13 Julii a. 1809 e Galla *Cyniphis Quercus gemmæ*, Linn. prope Sickershausen lecta. Alia cepi, Augusto mense locis nemorosis, in quercu. Observavi etiam Septembre mense hujus speciei feminam, cum gallam illam orbiculatam depressam lenticularem umbonatam basi arcte appressam rubram hirsutam, quæ in pagina foliorum quercus inferiori frequens occurrit, ictu vulneraret. Non causa igitur hujus gemmæ, sed parasita incolæ ejus videtur" (p. 43).

E. rosæ, Esenb. (Addenda, p. 415). "Habitat solitaria in gallis parvis globosis lævibus pisi magnitudine, primum pallidis, alterove latere roseis, demum lutescentibus, quæ prima æstate in pagina inferiori foliorum Rosæ centifoliæ horti mei Vratislavensis natæ, ad unam omnes hanc *Eurytomam*, nullam autem usquam Cyniphem edidere, neque spolia larvæ destructæ, quotquot dissecui, monstravere ut, itaque mihi persuasum sit, gallas istas ab ipsa *Eurytoma matre* ictu plantæ esse genitas ovuloque imposito impregnatas; ad hanc speciem referas feminam illam a cl. Gravenhorst in simili galla captam" (p. 41).

In his 'Hymenopterologische Studien' (2 Heft, 4to, 1856, p. 44), Förster has criticised Walker's distribution of the family, and given another tabulation of the four genera, without adding anything to our knowledge of the habits of the species.

Herr Förster (Beitr. z. Monogr. der Pteromalinen,

1 Heft, 4to, 1841, p. 6) comments upon Nees von Esenbeck's account of the habits of these insects as follows:—

E. signata, N. “Diese Art erzog ich aus denselben Gallen, wie Nees, und mit denselben zugleich *Pteromalus fasciculatus* und *sodalis* nob. sehr häufig. Weniger häufig erschienen aus denselben Gallen *Neuroterus petiolatus*, Kaltenbach, *Synergus rufiventris*, Kalt., und *Synergus parvus*, Kalt.; der erste ist also der Bewohner der Galle, während die beiden *Pteromalus*, die beiden *Synergus* und die *Eurytoma signata*, welche ich auch aus den vielkammerigen Schwammgallen an den Eichenzweigen mit *Teras terminalis*, Hart., erhielt; also im Ganzen 5 Parasitem nur als Zerstörer desselben angesehen werden müssen. Daraus geht mit Gewissheit hervor, dass *Eurytoma* keine Gallen erzeuge.”

E. abrotani, Ill. “Ich selbst erhielt diese Art aus Eichenblattgallen, welche wahrscheinlich der *Cynips disticha* angehören.”

E. rose, N. “Es scheint dies aber wirklich nicht der Fall zu seyn, denn ich erhielt dieselbe Art zwar aus Rosen, aber auch aus Blattgallen von derselben Grösse auf *Acer platanoides*. Diese letzteren Gallen waren von *Andricus scutellaris*, Kalt. bewohnt, in welchem *Pteromalus jucundus* nob. und *Pterom.*, *fasciculatus* nob. parasitisch leben. Es findet also hier wie bei *E. signata* desselbe Verhältniss statt, beide müssen Parasiten seyn, weil sie sonst wie oben von zweierlei Gallen wären.”

In the appendix to this ‘Beitrag,’ Förster has described eight new species of *Eurytoma*.

The late Dr. Thaddeus William Harris devoted not fewer than ten pages in the second edition of his ‘Treatise on some of the Insects of New England which are injurious to Vegetation’ (8vo, 1852, pp. 437), giving an account of a species of *Eurytoma* (*E. hordei*) which was supposed to have proved very injurious to the barley crops in the United States by forming gall-like swellings on the straw of barley and wheat, which prevent the proper development of the plants; hence called barley-straw insects and joint worms. The following is a very concise abstract of Dr. Harris's account:—These insects were first observed in 1829 and 1830, and on some farms the crop of grain scarcely exceeded the quantity of seed sown; most of the stalks were found to have a number of small worms within them near to the second joint, which had become hardened in the part attacked from the

interruption of the circulation of the sap, and in some places the cultivation of barley was given up in consequence thereof. When the barley is about eight or ten inches high the effects of the disease begin to be visible by a sudden check in the growth of the plants and the yellow colour of the lower leaves. If the butts of the straw are now examined they will be found to be irregularly swollen and discoloured between the second and third joints, and instead of being hollow are rendered solid, hard, and brittle, so that the stem above the diseased part is impoverished and seldom produces any grain. The worms are about one-tenth of an inch in length and of a golden or straw-colour, and in the month of November they appeared to have passed to the chrysalis state, which extends through the winter. In some cases the larva entered the pupa state early in the spring, and the perfect insects began to make their appearance on the 15th of June, escaping through minute perforations in the straw which they gnawed for this purpose. These larvæ differ entirely from those of *Cecidomyia* (which latter had been supposed by certain writers to have been the real cause of the mischief) in having the bodies softer and their skins more delicate and tender, whilst the form of the head and structure of the mouth are entirely unlike those of the *Cecidomyia* larvæ; the head is round and partially retractile; the jaws are lateral and hooked, they meet at the points, and are of a blackish colour, and apparently of a horny texture, being distinctly visible even with a pocket microscope; hence it is evident that these larvæ are hymenopterous, "and are not the larvæ of any dipterous insect." The perfect insects thus obtained proved to belong to the genus *Eurytoma*, and were described by Dr. Harris in the 'New England Farmer' for July 23rd, 1830 (vol. ix., p. 2), and in the first edition of his 'Treatise' as *Eurytoma hordei*. Eight years previously some of these insects, that came from a straw-bed in Cambridge (Mass.), were shown to Dr. Harris. They had proved very troublesome to children sleeping on the bed, their bites or stings being followed by considerable irritation and inflammation, which lasted several days; so numerous were the insects that it was found necessary to empty the bed-tick and burn the straw.

In 1851 the ravages of the joint worm in the wheat fields of Virginia attracted the attention of Dr. Fitch,

whose observations thereon appeared in 'The Cultivator' for October of that year. The disease in this case was found to be situated immediately above the lower joint in the sheathing base of the leaf, the substance of which, for a distance exceeding half an inch, was much swollen, and was changed to a more solid and wood-like texture, whilst the surface exhibited several long pale spots, slightly elevated like a blister. The hollow of the stem was entirely obliterated at some parts by the pressure of the enlarged portion of the sheath, and was hardly visible at others. Each of the blistered spots covered an elongated cavity, containing a footless worm or maggot about ten-hundredths of an inch long, of an oval form, rather more tapering posteriorly than towards the head, and divided by slight constrictions into thirteen segments. The worm was soft, shining, of an uniform milk-white colour, with a small V-shaped brown line marking the situation of the mouth. "So exactly," remarks Dr. Fitch, "does this worm in its form and appearance resemble the larvæ of the Hessian fly and other species of *Cecidomyia* which have fallen under my examination, that I entertain no doubt it pertains to the same genus of insects." A number of specimens of the diseased wheat were submitted to Drs. Harris and Fitch for investigation, the former of whom only obtained specimens of *Eurytoma* from them, all with one exception being females; whilst Dr. Fitch obtained above one hundred specimens of the same *Eurytoma*, all of which were females. The former observer obtained also one Chalcidian parasite belonging to the genus *Pteromalus*, whilst the latter also obtained another and different parasite belonging to the genus *Torymus*, with the hindmost thighs much thicker than the others and notched beneath at the end.

The ravages of the joint worms in the wheat-fields of Virginia subsequently attracted the attention of Prof. J. L. Cabell, who came to the conclusion that the joint worm is the larva of a hymenopterous, and not of a dipterous, insect. Dr. Harris completes his summary of the history of these insects with the following remarks:—"The foregoing account might be thought to afford conclusive evidence that the *Eurytoma* alone was the author of the mischief done to the wheat and barley, and that it is not a parasitical insect. In favour of this opinion we have the fact that hitherto no person has

succeeded in obtaining from the diseased wheat-straw so much as a single specimen of *Cecidomyia*, while both the wheat and the barley straw have yielded to several observers, in repeated instances, numerous specimens of the same kind of *Eurytoma* and nothing else, saving an extremely small number of lesser parasites. The determinations of this difficult and interesting question is of much importance in a scientific and an economical point of view. We are to consider, in destroying the *Eurytoma*, whether we shall kill an enemy or a friend. If it be a parasite, as the almost universal opinion of entomologists would lead us to believe, it would be the height of folly to attempt to interfere with its operation. On the other hand, if we can show it to be a plant-eating insect, we may use such means as are in our power towards checking its career, not only with perfect safety, but with eminent advantage."—'Treatise,' p. 445.

In the 'American Agriculturist,' New York, August, 1861, Dr. Fitch reasserts that this *Eurytoma* is the origin of the joint worm, and enumerates four species of the *Eurytomæ*:—

1. *E. hordei*, Harris, which has the shanks of all the legs black.

2. *E. fulvipes*, Fitch, Journ. New York State Agr. Soc. ix. 115, with the shanks and thighs tawny yellow.

3. *E. tritici*, Fitch, *l. c.*, with the shanks of the fore legs pale yellow and of the others black.

4. *E. secalis*, Fitch, *n. s.* The rye-fly, with the fore and hind shanks pale yellow, and the middle ones black. Very common in Connecticut.

These insects are described in detail, and their economy given, in Dr. Fitch's 'Seventh Report on the Noxious Insects of New York,' pp. 151—165.

In the 'Bulletin de la Société Imperiale des Naturalistes de Moscow,' 1880, part iii., Prof. K. Lindeman has published a memoir on the *Eurytoma hordei* and *Cecidomyia ceralis*, which had for five years previously proved very injurious in the Russian State of Mohilev to the rye crops; and in the 4th part of the same volume of the Moscow Bulletin, Prof. Lindeman has described several Chalcidideous parasites which he had reared from the diseased joints of the rye, as well as a distinct species of *Eurytoma* (*E. albinervis*), which also resides in the knotted joints of the rye.

Dr. Ratzeburg ('Ichneumonien Forstinsecten,' Bd. i.,

4to, 1844, p. 171) has given a revision of the genus *Eurytoma*, in which the divisions and subgenera proposed by Walker and Förster are rejected, and objecting to the supposed phytophagous character of some of the species, as proposed by Nees v. Esenbeck; all the species observed by him being asserted to be parasites, some of them being even supposed to be parasites on the parasites (*Schmarotzer*—*Schmarotzer*) of the gall-fly or other insects from which they have been observed to have originated. Moreover, he gives instances of the polyphagism and even pantophagism of some of the species, several of which are parasites on wood-boring Coleoptera of the genera *Hylesinus* and *Eccoctogaster*, as well as upon *Nemati*, *Saperde*, and *Magdalis*.

The species described by Dr. Ratzeburg are:—

1. *E. signata* ‘Wahrscheinlich der Haupt-Eichen-Gallenschmarotzer unter den Eurytomen.’
2. *E. flavovaria*, n. s. Fourteen male specimens reared from *Hylesinus fraxini* from Upper Silesia.
3. *E. flavo-scapularis*, n. s. Also parasitic on *Hylesinus fraxini*.
4. *E. Abrotani*.
5. *E. verticillata*, Nees.
6. *E. eccoctogastri*, n. s. From a “kranken apfel-zweigen” in which *Eccoctogaster rugulosus*, *Saperda picea*, and a *Magdalis* were found.
7. *E. abieticola*, n. s. From “Fichtenknüppeln” inhabited by *Magdalis violacea*.
8. *E. ischioxanthus*. Obtained with *E. flavovaria* from *Hylesinus fraxini*.

In the second volume of the same work, 1848 (p. 177), Dr. Ratzeburg has added the descriptions of three additional species of *Eurytoma*:—

9. *E. aciculata*. Obtained both males and females from “Weidengallen” and from *Salix viminalis*, probably being parasitic on *Nematus angustus*.
10. *E. striolata*. From *Eccoctogaster intricatus*.
11. *E. costata*. Males obtained from cocoons of the *Microgaster* of *Pontia cratægi*.

And in the third volume of the same work, 1852, p. 220, four more species of *Eurytoma* are described:—

12. *E. extincta*. Parasitic on *Nematus angustus*. “Von Hrn. Brischke aus dem Stiele der Weidenrosen erzogen.”
13. *E. pictorum*. Parasitic on *Hylesinus minimus*.

14. *E. microneura*. From a *Cecidomyia* upon "Weidenrosen-zucht."

15. *E. brunniventris*. From an oak-gall.

With the addition of—

16. *E. plumata*, Ill. From the *Microgaster* of a *Liparis*.

The group of *Eurytomides*, and especially the real economy of *Eurytoma hordei*, engaged the attention of the late Benjamin D. Walsh, M.A., and formed the subject of two elaborate memoirs published in the 'American Entomologist,' vol. i., pp. 149—159 (1869), and vol. ii., pp. 297, 329, and 367 (1870).

The first of these memoirs is especially devoted to the joint worm (*Isosoma hordei*), the larva of which is described as but little more than one-eighth of an inch long, and of a pale yellow colour, with the exception of the jaws, which are dark brown. It inhabits a little cell, which is situated in the internal substance of the stem of the affected plant of wheat, barley, or rye, usually a short distance above the first or second knot from the root, the outer surface of the stem being elevated in a corresponding elongate blister-like swelling; and when, as is generally the case, from three to ten of these cells lie close together in the same spot, the whole forms a woody enlargement honeycombed by cells, and is in reality a many-celled or "polythalamous" gall. Occasionally, but rarely, galls are situated in the middle of the internode, or even close to the upper knot. The mischief done by these insects is in certain localities "seriously great." In 1851, throughout a large portion of Virginia, "many crops of wheat were hardly worth cutting on account of their attacks." In central New York Mr. G. Geddes, late President of the New York State Agricultural Society, writes:—"Formerly we expected forty bushels of barley to the acre; now we cannot rely on more than twenty."—('Trans. N. Y. Agr. Soc.,' 1859, p. 332).

The fact of the deposition of the eggs by the female *E. hordei* in the healthy stalks of the plants was distinctly observed and described by Mr. Pettit, of Grimsby, Canada West ('Canada Farmer,' 1867, p. 268). He states that he had "watched the growing barley, and on the 10th of June found the perfect insects actively at work ovipositing in the then healthy stalks of the plant." After leisurely creeping up and down the plant, "the

females, head downwards, begin by bending the abdomen downward, and placing the tip of the ovipositor on the straw at right angles with the body, when the abdomen resumes its natural position, and the ovipositor is gradually worked into the plant to its full extent. With the aid of a good lens, and by pulling up the plants on which they were at work (which did not appear to disconcert them in the least) I could view the whole operation."

Mr. Walsh adds that upon July 3rd he examined "a large lot of the green barley-galls received from Mr. Pettit, and found the larva of the joint fly almost half grown, that is, from 0.004 to 0.006 inch long, and about five times as long as wide. In these green galls, upon the most careful search, he could find no gall-gnat larvæ, nor any vestiges of such larvæ." If the so-called joint-worm fly were really a parasite, we must certainly have discovered, at the early period of the year, a few specimens of the larvæ upon which it was parasitic, or at all events some traces of their handiwork." Mr. Walsh therefore comes to the inevitable conclusion (already arrived at by Harris and Fitch, and contrary to the opinion which Walsh had expressed previously in the 'Practical Entomologist,' i., pp. 10—12 and 37, 38) "that the joint fly was the real author of these galls, and we think it right to bear this public testimony to the correctness of their entomological inferences" (p. 151).

Mr. Walsh then describes a truly parasitic Chalcidid insect (*Semiotellus chalcidiphagus*), one of the larvæ of which "emerged under our very eyes from the body of a joint worm"; whilst in other instances he had found the parasitic larvæ attached externally to its victim, in the manner common with the larvæ of many *Chalcis* flies. He then details his observations on many specimens of the *I. hordei*, which he had reared from Canada barley-galls, proving that Dr. Fitch's four species of joint-worm flies are mere varieties of one and the same species.

Adopting an opinion expressed by Professor Agassiz* ('Essay on Classification,' p. 59), Mr. Walsh insists on

* "The more I learn upon this subject," says Agassiz, "the more am I struck with the similarity in the very movements, the general habits, and even the intonation of the voices of animals belonging to the same family."

the law of UNITY OF HABITS in insects and other animals, and which he briefly states as follows:—"In the case of all known animals, species belonging to the same genus have the same, or nearly the same, habits, and this is also partially true of genera belonging to the same family, but not unfrequently genera belonging to the same family have very widely distinct habits." "Consequently, as the genus and the habits of any particular species of animal are both of them determined by the structure, when the genus of two species is the same, the habits also must of necessity be the same, or very nearly the same."

In illustration of these principles Mr. Walsh cites the case of *Zabrus* (a genus belonging to the great carnivorous family of ground beetles, *Carabidæ*), which feeds upon living and growing vegetables; also the genus *Oödes* (belonging to the same family of ground beetles), which generally makes for the water when endeavouring to escape, crawling under floating rubbish, and the genera *Arma* and *Stiretrus* (belonging to the family of the plant bugs, Heteroptera), but which have very stout robust beaks suitable for piercing the bodies of other insects, and cannibal in their habits; whilst all the other *Scutelleridæ* have tender beaks only for piercing vegetation. Upon minutely examining the perfect joint-worm fly, and comparing it with the other *Eurytomides*, Mr. Walsh ascertained that the former neither belonged to the genera *Eurytoma* nor *Decatoma*, to which the greater portion of these *Eurytomides* are referable, but to a distinct genus, *Isosoma*, Wlk.

To the genus *Isosoma* (with 9-jointed antennæ in both sexes, not counting the minute annuli nor any articulation in the terminal joint), Mr. Walsh refers the "notorious joint-worm fly, which I have clearly ascertained to be the veritable author of the galls upon the stems of wheat, barley, and rye, figures of which galls are given."—('American Entomologist,' vol. ii., p. 329). From Harris and Fitch, down to Glover and Packard, all authors have hitherto referred this insect to the genus *Eurytoma*, from which, however, it differs essentially. If it could with any propriety be referred to that genus we should then have a case of the same genus including both parasitic and plant-feeding species, and I do not believe that any such violation of the great law of the UNITY OF HABITS can be met with anywhere in Nature. As

long ago as 1867 I published, in the 'Canada Farmer' for that year (pp. 267-8), a short article acknowledging my error (as given to the world in the 'Practical Entomologist' i., pp. 10—12 and 37, 38) in disputing the conclusions at which Harris and Fitch had many years before arrived, namely, that the joint-worm fly is the real author of the joint-worm galls. In this same article will also be found the following passage, in regard to the generic determination of this insect:—"The joint-worm fly differs generically from all the numerous species of the *Eurytoma* group which I have ascertained to be parasitic on other insects, and cannot, I think, be referred with any propriety to the genus *Eurytoma*, although it undoubtedly belongs to the *Eurytoma* group." "Certainly, if preceding authors had referred this species to its proper genus, I should not have been so unwilling to believe in its being a true vegetable feeder. As soon as I became acquainted with it the mystery was solved at once."—'American Entomologist,' p. 329.

Mr. Walsh then discusses the question of the specific identity of the specimens of *I. hordei* reared from wheat, rye, and barley, and insists that Fitch's four species, founded on the different food-plant and colour of the legs of the individuals, can only be considered as varieties of one species.

No other species of *Isosoma* is described by Mr. Walsh.

In the second of Mr. Walsh's memoirs the genera *Eurytoma*, *Decatoma*, and *Isosoma* were adopted. In *Eurytoma* (with 8-jointed male and 8-jointed female antennæ, not counting the minute annulus or annuli between the 2nd and 3rd joints, or any apparent articulation in the terminal joint or clava), eight species were described, including the *E. studiosa*, Say, the remainder being new species.

1. *E. bicolor*, W., p. 298. Reared from rough, woody, subglobular, black, fungoid swellings upon the twigs of black oak infested by an undescribed species of gall-fly.

2. *E. prunicola*, W., p. 298. Bred from oak-galls of *Cynips Quercus prunus*, Walsh.

Var. *E. globulicola*. Bred from the Cynipideous oak-gall, *Cynips Q. globulus*, Fitch.

3. *E. auriceps*, W., p. 299. Bred from the Cynipideous oak-gall of *Quercus erinaceus*, Walsh (= *Q. pisum*, Fitch?); also from galls of *Q. spongifica*, O. S., and *Q. hirta*, Bassett, with a single female from the Cynipideous rose-gall, *radicum*. O. S.

Var. *seminatrix*. Bred from the Cynipideous oak-gall, *seminator*, Harris.

4. *E. punctiventris*, W., p. 299. Bred from the Cynipideous oak-gall, *Q. mamma*, Walsh.

5. *E. abnormicornis*, W., p. 299. Captured at large.

6. *E. diastrophii*, W., p. 299. Bred from the Cynipideous bramble-gall of *Diastrophus nebulosus*, O. S., and from an oak fungoid-gall.

Var. *Bolteri*, Riley. Reared from the Lepidopterous golden-rod gall of *Gelechia gallæsolidaginis*, Riley.

7. *E. studiosa*, Say, W., p. 299. Bred from various Cynipideous oak-galls; from Tenthredinideous willow galls; from Cecidomyideous galls; from Aphidian leaf-galls; from Coccideous leaf-gall; and from a black fungoid swelling on the pig-nut hickory.

8. *E. gigantea*, W., p. 300. Captured at large.

In *Decatoma* the male antennæ are described as 7-jointed, and those of the female as 8-jointed (not counting the annuli nor any articulation in the terminal joint).

Five new species are described in this genus:—

1. *D. varians*, W., p. 300. Bred from the Cynipideous oak-galls, *Q. podagræ*, Walsh, and *Q. spongifica*, O. S.

Var. *dubia*. Bred from the Cynipideous oak-gall, *Q. mamma*, Walsh.

2. *D. nigriceps*, W., p. 300. Bred from the Cynipideous oak-gall, *Q. ficus*, Fitch.

Var. *excrucians*. From the white oak-gall, *seminator*, Harris.

3. *D. hyalinipennis*, W., p. 301. Captured at large.

4. *D. simplicistigma*, W., p. 301. Bred from the Cynipideous oak-galls, *Q. eriuaceus*, Walsh, and *Q. petiolicola*, Bassett.

5. *D. nubilistigma*. Bred from the Cecidomyideous willow-gall, *S. batatas*, Walsh, and a swamp white oak-gall.

In the Proceedings of the Entomological Society of London for 4th July, 1870 ('Journ. Proc.,' p. xxx.), it is stated that Mr. Albert Müller exhibited some galls upon *Anmophila arundinacea*, found in the preceding autumn by Mr. J. Traill, about two miles north of Aberdeen; they occurred rather abundantly on stunted specimens, one gall on each plant; the gall consisted of the imbricate closely-sheathed leaves of a top shoot, and contained a single longitudinal narrow cell from two to three lines long, the

upper part of which was pierced by the escaping insect, which had not, however, been detected.

The same insect is recorded by Herr Ritsema, in the 'Proceedings' of the Entomological Society of the Netherlands ('Tijdschrift voor Entomologie,' 2nd serie, vol. vi., 1871, p. 148), to have been found in different parts of Holland, especially near Zandvoort, where it was first found by H. Ritsema's brother in 1867. It had also been observed by HH. Weyenbergh and Snellen van Vollenhoven, and had also been previously recorded in the 'Archives Neerlandaises des Sciences exactes,' vol. v., 1870. By these Dutch entomologists it had been ascertained that the galls in question were made by *Eurytoma longipennis*.*

Professor G. H. French, of Carbondale, Illinois, described in the 'Prairie Farmer' for Dec. 31st, 1881, and more fully in the 'Canadian Naturalist' for Jan., 1882, both sexes of a species which he believed to be a new wheat pest, under the title of *Isosoma Allynii*; the larvæ of which were found inside the stalks of growing wheat in Southern Illinois, before the ripening of the grain, and in the straw and stubble during the rest of the summer. They were found mostly in the interior of the 1st and 2nd internodes below the one supporting the head, usually singly, but sometimes more than one in the same internode. They produce no swelling or gall, as do the larvæ of *I. hordei*, but feed upon the soft tissue of the interior of the stalks. They are about 0.15 in. long, rather slender, tapering slightly towards either end, footless, but when in motion seeming to have the power of pushing out the substigmatal portion of the segments, a distinct transverse head about two-thirds of the width of the body, with a pair of brown jaws. Colour yellow, approaching to pale orange. The pupæ vary from about

* Mr. Walker has mentioned the discovery of the economy of this species in his 'Notes on Chalcidæ,' in which he has given a series of notes on numerous British species of Eurytomides, together with the descriptions of two new genera *Philachyra*, Hal., of which the male is winged and the female apterous, of which the type *P. Ips* was found in straw roofs near Lucca, Italy. The other genus, *Aiolomorphus* (type *A. rhopaloides*), is from Hong Kong (no museum where it may be seen is mentioned). Mr. Walker also mentions (*op. cit.*, p. 7) that he was indebted to Mr. Saunders, of Ontario, Canada, for specimens of *Isosoma vitis*, which is mentioned in the 'Zoologist' as being cradled in grape-stones.

0·08 to 0·12 in. long, black, and of the usual hymenopterous form.

Another species of *Isosoma* was also described by Prof. French in the same memoir, under the name of *Isosoma elymi*, the larvæ of which were found on the interior of the culms of *Elymus canadensis* in about the middle internodes of the stalks, very much as the larvæ of the preceding species are to be found on the interior of wheat culms. While, however, the wheat larvæ are generally just above the joint, these may be found in any part of the interior of the internode. Both feed upon the soft tissue of the interior of the stalk, and do not produce any enlargement; the only noticeable effect from the outside is that internodes containing larvæ are usually shorter than the others. The larvæ are footless, about 0·10 in. long when still, and 0·04 in. wide in the widest part, with brown jaws. Colour very pale yellow, and, like the preceding, there appear to be slight projections from the sides of the body at times.

Specimens of the first of these two species having been submitted by Prof. French to Mr. Riley, and to myself through Miss Ormerod, prove to belong not to *Isosoma*, but are "a species of *Eupelmus*, parasitic, doubtless, on some of the wheat-stalk feeders, and probably on some species of *Chlorops*" ('Amer. Naturalist,' March, 1882, p. 247).

An additional species of *Isosoma* which affects wheat has just been described by Mr. Riley in the 'Rural New Yorker,' and again at greater detail in the 'American Naturalist' for March, 1882, under the name of *Isosoma tritici*, received from Tennessee and Missouri. Although congeneric with the joint worm (*I. hordei*), it differs widely from the latter in habits and appearance. The joint worm forms a gall-like swelling at a joint near the base of the stalk, whilst the species under consideration feeds on the interior of the stalk between the joints higher up, without causing a swelling. The larva figured by Mr. Riley is long and quite eruciform, with the segments of the body distinct and of nearly equal width throughout its whole length; the head is furnished with two very small filiform porrected antennæ, arising from a thickened basal joint; the mandibles are deflexed, nearly triangular, acute at the tip, with a small conical tooth near the apex of the inner margin. Mr. Riley adds that "it is worthy of remark that this new species seems to be quite closely related to the

European *Isosoma linearis* which was bred from wheat by Dr. Giraud,* who considered it inquiline in the swellings formed by the dipterous *Ocithiphila polystigma* of Meigen. Kaltenbach remarks, however, that although obtaining the *Isosoma* many times from the wheat, he never succeeded in seeing this dipteran—a very suggestive fact.”

The attention of the members of the Scientific Committee of the Horticultural Society of London was directed by Mr. Bateman, on the 2nd March, 1869, to the injury committed by several insects on the bud of an exotic species of Orchid, beneath the overlapping leaves of which two white fleshy grub-like larvæ (evidently Curculionideous, and closely resembling those of the common nut weevil) were securely nestled, and which had been feeding upon the thickened substance of the leaves, the surface of which was eaten off to some distance without any hole being gnawed through the leaf. Immediately in the vicinity of these larvæ† were also found several minute dead pupæ lying in a mass of hard dry particles of dark-coloured matter (doubtless the excrement of the larvæ from which the pupæ had been developed). These pupæ were Hymenopterous, and by carefully scaling off the thin horny external pellicle under the microscope they were ascertained to belong to the family *Chalcididae* and to the genus *Isosoma*, both sexes of which were thus brought to life. In this case it was evident, 1st, that the weevil larvæ were uninjured, so that the *Isosoma* were not parasitic upon them; 2nd, that the *Isosoma* larvæ had already gone through the whole process of their economy, whether phytophagous or entomophagous; and 3rd, as no trace could be perceived of a third species of insect, the probability seems evident that the *Isosoma* were not parasitic on other insects. For the sake of identification I proposed the name of *Isosoma orchidearum* for this species (‘Gardeners’ Chronicle,’ 27th Nov., 1869, p. 230).

The following is a description of the species :—

* The important memoir of Dr. Giraud (‘sur les Insectes qui vivent sur le Roseau commun’) will be noticed in a supplementary article at the end of the present volume.

† It might be assumed, from the presence of the weevil larvæ and parasitic pupæ in the same burrow, that the latter were parasitic upon the former; but it will be perceived that the larvæ were still well and active, whilst the parasites had already completed the larva period of their lives and had become pupæ.

Isosoma orchidearum, Westw. (Pl. XIII., figs 1 & 4).

Nigrum, modice elongatum, capite et thorace rude punctatis, antennis maris longe pilosis, articulis intermediis crassioribus singulo apice strangulato, articulis 2^{do} brevi, annulo inter hunc et sequentem articulum, 4 proximis sensim minoribus, 7^{mo} subovali, 8^{mo} fere præcedenti æquali, ultimo 9^{no} parvo subconico; fœminæ articulis 7 pone anulum fere æqualibus subovalibus, 8^{vo} præcedenti parum majori, 9^{no} longiori, articulo 1^{mo} hujus sexus basi fulvo, maris nigro; pedibus maris geniculis tarsisque tibiisque anticis fere toto fulvis, articulo ultimo tarsorum nigro: fœminæ tibiis intermediis etiam fulvis. Abdomine nitido glabro compresso, maris ovali apice rotundato pedunculo longiori; fœminæ pedunculo breviori, apice abdominis acuto. Alis pallide fumosis immaculatis iridescentibus. Long. corp. 4—5 mm.; expans. alar. 6—7½ mm.

Hab. In gemmis *Cattleyæ* cujusdam Brasilianæ.

In April, 1881, I received from a correspondent (Inquirer) several buds of a species of *Cattleya*, a Brazilian and Mexican genus of Orchids, which had been injured by the larvæ of a small Hymenopterous insect, of which a figure is given in the accompanying Plate xiii. Fig. 10 also represents one of the *Cattleya* buds cut open at the base, showing three of the larvæ ('Gard. Chron.,' 30th April, 1881, p. 575).

From another correspondent (E. C.) I also received several *Cattleya* buds which had holes bored in the interior, within which I found several specimens of the *Isosoma orchidearum* of both sexes in the winged state ('Gard. Chron.,' 22nd October, 1881, p. 542). This discovery led to my publishing a short note "On the Abnormal Economy in certain Species of the *Eurytomides*" in the 'Gard. Chron.,' 29th October, 1881, p. 567.

Plate xiii., fig. 1, represents the male of *I. orchidearum*, the separate outline fig. 3 representing the delicate ceratotheca or pupal sheath of the flagellum of the antenna, not exhibiting the slightest trace of the nodosity of those organs in the imago state.

Fig. 4 represents the female, with (fig. 6) the ceratotheca of its antenna.

Fig. 8 represents a portion of the shoot of the orchidaceous plant, communicated by Mr. Bateman, partially opened, showing one large larva of a weevil and four

pupæ of the *Isosoma*, with the pellets of excrement discharged by the larvæ before their transformation to that state; one of the pupæ seen laterally is represented in fig. 14, highly magnified.

Fig. 10 represents a *Cattleyia* bud cut open at the base, showing three of the larvæ of the *Isosoma*; whilst fig. 9 represents another *Cattleyia* bud cut open, showing six of the pupæ. The larva itself is represented in fig. 11. It is considerably more swollen than that of *I. tritici*, as figured by Mr. Riley, the sides of the body showing the swollen portions, which are capable of greater or less dilatation. The figure of this larva will be seen closely to resemble that of *Blastophaga Psenes*, figured in Plate iv., fig. 26.

Fig. 12 represents the head of the larvæ seen laterally and rather obliquely, with the two minute antennæ each arising from a dilated fleshy base; and fig. 13 represents the front view of the head, with the two bidentate mandibles and two swollen lateral parts, which probably represent the maxillæ.

Plate xiv., fig. 18, represents the larva of *Isosoma tritici*, copied from Prof. Riley's figure.

Mr. T. Whitmarsh, of Wilton, near Salisbury, has paid much attention to the *Cynipidæ*, having reared a large number of the species, and has been so good as to furnish me with a number of microscopical preparations of them. Amongst them are specimens of both sexes of a species of *Isosoma* which he reared from swellings on grass (some with and some without holes in them), gathered in 1873, from which the *Isosomæ* were produced in the latter part of June and beginning of July in the following year. The antennæ in the male specimens thus obtained are long, considerably pilose, with the 2nd joint short (scarcely longer than thick), followed by a minute annulus, and this by seven distinct joints, which gradually become rather more slender and shorter towards the end of the antennæ; the extremity of each of these joints is strangulated, and the terminal joint is quite entire, longer and more slender than the preceding joint, with the tip pointed. The female antennæ have the seven terminal joints also quite distinct and but very slightly thickened towards the tip of the antennæ, without any distinct subarticulation visible in the terminal joints. The clypeus in the female is produced in the centre, and slightly furcate.

Another species of *Isosoma*, the antennæ of which exactly agree with those of *I. orchidearum*, was reared by Mr. Whitmarsh from hard hollow pink pepper-corn galls on the under side of oak-leaves gathered in August, 1872, the flies immediately making their exit from the galls. The microscopical preparations made of this species by Mr. Whitmarsh exhibit several parts of its structure so clearly that I have thought it desirable to represent them, as the species which attacks the *Cattleya* buds will doubtless possess a perfectly similar organisation.

The mandibles (Pl. xiv., fig. 15*a*) are very robust, subtriangular, pointed at the tip with one acute and one broad truncated tooth on the inner edge. The lower parts of the mouth are well defined. The maxillæ (fig. 15) have a broad basal portion working upon a narrow muscular attachment; whilst the apical portion is formed of two blades, slightly curved, obtuse at the tips, setose on the outer margin; and the maxillary palpi are distinctly 4-jointed, the three basal joints small, nearly equal in size (the 2nd being rather larger than the others); and the 4th is as long as the rest united, and slightly dilated and obliquely truncated at the tip.* The mentum is semiovate, the anterior portion being narrowed on either side; it is affixed upon a narrow, elongated triangular stipes; the labium is as long as the mentum, rounded at its extremity, and the labial palpi are distinctly 3-jointed, the basal joint being the thickest, the 2nd joint the shortest, and the 3rd slender, obtuse, and setose at the tip. The body of the male is terminated by a retractile flattened elongated penis, pointed at its extremity (fig. 17), and is furnished with a pair of short flattened claspers, each having three short acute teeth on its outer apical portion, similar in position and shape to the organs in the males of *Sycophaga crassipes* (see Plate iii., figs. 15 to 18). The organs of oviposition in the female are represented in fig. 16, in which the sheath

* Mr. Curtis, 'Brit. Entom.,' pl. 345 (February, 1831), represents the structural details of *Decatoma biguttata*, Swederus, figuring the maxillary palpi as 3-jointed and the labial palpi as 2-jointed. He states, however, that Mr. Haliday had observed that the maxillary palpi of *E. longula*, Dalman? are 4-jointed, whilst the labial are 2-jointed. In a specimen of, I believe, *E. (Decatoma) biguttata*, reared from soft cherry-like galls on the under side of oak-leaves by Mr. Whitmarsh and prepared in Canada balsam, the maxillary palpi are distinctly 4-jointed.

is withdrawn from its flattened horny scabbard; it is very slender, armed at its apex with several very fine teeth; and in the preparation here figured one of the delicate spiculæ is seen entering the sheath at its base, whilst another of the spiculæ is more withdrawn, entering the sheath at a little distance beyond its base.

As a further illustration of the relationship between some of the fig insects and other well known parasitic *Chalcididæ*, I have added a figure (Plate xiv., fig. 21) of the generative organs of the males of one of the most curious Pteromalideous species, *Platymesopus apicalis*, Westw.,* which has been reared by Mr. T. Whitmarsh from the small woody bud-like oak-galls on the preceding year's shoots, a little below the current year's shoots. The species is remarkable for the dilated middle tibiæ terminated by a small patch of short black hairs, and by the delicate pale yellow antennæ terminated by an oval black clava. In my fig. 21 it will be observed that the elongated exerted penis is furnished with a pair of flattened claspers, each having five or six short curved spines on its outer apical margin, which are preceded by a pair of slender short filiform 2-jointed lateral appendages, each having a terminal bristle directed outwards.

I terminate this memoir with the description and figures of both sexes of the largest and finest species of the Eurytomides with which I am acquainted, which has been communicated to me by G. H. K. Thwaites, now of Kandy, Ceylon. It was found by him "feeding or inhabiting some fleshy galls upon the leaves of *Ficus Tjiela*, together with their Ichneumonideous parasites." From what has been already advanced in this memoir, I have but little doubt that this beautiful species is the real maker of the gall, from which specimens of both sexes have been reared.

* *Platymesopus apicalis*, n. s.—Capite et thorace læte viridibus, abdomine nigricanti, fascia lutea transversa prope basin, antennis pedibusque stramineo-flavis, illis thoracis longitudine gracilibus, articulis 6 inter annulos et clavam triarticulatam apicalem nigram; tibiis intermediis intus dilatatione tenui semiovale apice externo fasciculo brevi setarum nigrarum instructo. Long. corp. 2 mm. Expans. alar. $2\frac{1}{2}$ mm.

Habitat in galla parva lignea gemmarum *Quercus*, mense Junio exeunti.

Obs. Magnitudine et coloribus *Mesopolobo fasciventri*, Westw. simillimus.

Eurytoma taprobanica, Westw. (Pl. XIV., figs. 23 & 25).

Species magna et insignis. Mas, rufo-luteus, capitis vertice, dorso pro- et meso-noti, scutello, metanoto tenui, pedunculo abdomine et segmentis apicalibus abdominis nigris; antennis crassioribus, 9-articulatis, articulo 2^{ndo} parvo, 3^{tio} longo, reliquis 6- magnitudine decreascentibus, omnibus (1^{mo} excepto) setis numerosis obtectis, pedibus fulvo-rufis femoribus intermediis in fossula inter coxas et basin alarum receptis. Fœmina, capite et thorace ferrugineis valde punctatis, metanoto brevi nigro, abdomine late-ovali nigro glaberrimo, antennis nigris articulis duobus basalibus rufescentibus 8-articulatis articulo ultimo, ut videtur 3-articulato; pedibus nigris geniculis tarsisque rufescentibus, alis in utroque sexu fere hyalinis iridescentibus vix infumatis nubila fusca substigmatali. Long. corp. 6 mm. Expans. alar. 10 mm.

Hab. In insula Taprobana in gallis *Ficus Tjielæ* (D. Thwaites) mecum amicissime communicata. In Mus. Oxoniæ.

From the same galls of *Ficus Tjiela* were also reared by Mr. Thwaites a number of Ichneumonideous parasites, of which only females were sent to me. The following is their description:—

Bracon sculptilis, Westw. (Pl. XIV., fig. 27).

Capite luteo, vertice nigro, antennis gracillimis nigris; thorace brevi ovato, fulvo, metanoto nigro glabro; abdomine obscure-luteo, segmentorum dorso nigro punctatissimo, singulo segmento serie transversa basali punctorum majorum oblongorum, segmentis terminalibus, fere omnino lutescentibus; pedibus pallide luteis, femoribus et tibiis 2 posticis nigris geniculis luteis; alis fere hyalinis, vix infumatis, iridescentibus, cellulis 1^{ma} et 2^{nda} submarginalibus fere æqualibus, oviductu corporis longitudine sub pectus incurvo. Long. corp. 5½ mm. Expans. alar. 14 mm.

Hab. In insula Taprobana. In gallis *Ficus Tjiela* parasitica (D. Thwaites) mecum communicata. In Mus. Oxoniæ.

EXPLANATION OF PLATES.

PLATE XIII.

- FIG. 1. *Isosoma orchidearum*, male, magnified.
 2. Antenna; and 3, ceratotheca of flagellum of ditto.
 4. *Isosoma orchidearum*, female, magnified.
 5. Antenna; and 6, ceratotheca of flagellum of ditto.
 7. Fore leg of ditto.
 8. Portion of stem of an Orchideous plant, with weevil larva and parasitic pupæ *in situ*.
 9. Bud of Brazilian *Cattleya*, with pupæ of *Isosoma orchidearum*.
 10. Buds of *Cattleya*, with larvæ of *Isosoma orchidearum*.
 11. Larva of ditto, magnified.
 12. Head of larva, seen sideways, rather obliquely.
 13. Front of ditto, with bidentate mandibles.
 14. Pupa of *Isosoma orchidearum*.

PLATE XIV.

15. Maxilla and labium of male *Isosoma* sp.; reared from peppercorn-galls on under side of oak-leaves; and 15a, mandible of ditto.
 16. Ovipositor of female of ditto.
 17. Penis of male of ditto, with its two claspers.
 18. Larva of *Isosomia hordei*, after Fitch.
 19. Antenna of larva of ditto.
 20. Mandibles of ditto.
 21. Penis of *Platymesopus apicalis*, male, and its appendages.
 22. Middle tibia and tarsus of ditto.
 23. *Eurytoma taprobanica*, male.
 24. Antenna of ditto.
 25. *Eurytoma taprobanica*, female.
 26. Antenna of ditto.
 27. *Bracon sculptilis*.